



## 19BMT202

# Biomedical Sensors and Measurement

## Unit – 4 Measurement of Non-Electrical Parameters

### Two Marks

#### What are vital signs?

Vital signs are measurements of the body's most basic functions. The four main vital signs routinely monitored by medical professionals and health care providers include the following:

- Body temperature
- Pulse rate
- Respiration rate (rate of breathing)
- Blood pressure (Blood pressure is not considered a vital sign, but is often measured along with the vital signs.)

Vital signs are useful in detecting or monitoring medical problems. Vital signs can be measured in a medical setting, at home, at the site of a medical emergency, or elsewhere.

#### What is body temperature?

The normal body temperature of a person varies depending on gender, recent activity, food and fluid consumption, time of day, and, in women, the stage of the menstrual cycle. Normal body temperature can range from 97.8 degrees F (or Fahrenheit, equivalent to 36.5 degrees C, or Celsius) to 99 degrees F (37.2 degrees C) for a healthy adult. A person's body temperature can be taken in any of the following ways:

- **Orally.** Temperature can be taken by mouth using either the classic glass thermometer, or the more modern digital thermometers that use an electronic probe to measure body temperature.
- **Rectally.** Temperatures taken rectally (using a glass or digital thermometer) tend to be 0.5 to 0.7 degrees F higher than when taken by mouth.



- **Axillary.** Temperatures can be taken under the arm using a glass or digital thermometer. Temperatures taken by this route tend to be 0.3 to 0.4 degrees F lower than those temperatures taken by mouth.
- **By ear.** A special thermometer can quickly measure the temperature of the ear drum, which reflects the body's core temperature (the temperature of the internal organs).
- **By skin.** A special thermometer can quickly measure the temperature of the skin on the forehead.

Body temperature may be abnormal due to fever (high temperature) or **hypothermia** (low temperature). A fever is indicated when body temperature rises about one degree or more over the normal temperature of 98.6 degrees Fahrenheit, according to the American Academy of Family Physicians. Hypothermia is defined as a drop in body temperature below 95 degrees Fahrenheit.

## What is the pulse rate?

The pulse rate is a measurement of the heart rate, or the number of times the heart beats per minute. As the heart pushes blood through the arteries, the arteries expand and contract with the flow of the blood. Taking a pulse not only measures the heart rate, but also can indicate the following:

- Heart rhythm
- Strength of the pulse

The normal pulse for healthy adults ranges from 60 to 100 beats per minute. The pulse rate may fluctuate and increase with exercise, illness, injury, and emotions. Females ages 12 and older, in general, tend to have faster heart rates than do males. Athletes, such as runners, who do a lot of cardiovascular conditioning, may have heart rates near 40 beats per minute and experience no problems.

## How to check your pulse?

As the heart forces blood through the arteries, you feel the beats by firmly pressing on the arteries, which are located close to the surface of the skin at certain points of the body. The pulse can be found on the side of the neck, on the inside of the elbow, or at the wrist. For most people, it is easiest to take the pulse at the wrist. If you use the lower neck, be sure not to press too hard, and never press on the pulses on both sides of the lower neck at the same time to prevent blocking blood flow to the brain. When taking your pulse:



- Using the first and second fingertips, press firmly but gently on the arteries until you feel a pulse.
- Begin counting the pulse when the clock's second hand is on the 12.
- Count your pulse for 60 seconds (or for 15 seconds and then multiply by four to calculate beats per minute).

## What is the respiration rate?

The respiration rate is the number of breaths a person takes per minute. The rate is usually measured when a person is at rest and simply involves counting the number of breaths for one minute by counting how many times the chest rises. Respiration rates may increase with fever, illness, and other medical conditions. When checking respiration, it is important to also note whether a person has any difficulty breathing.

Normal respiration rates for an adult person at rest range from 12 to 16 breaths per minute.

## What is blood pressure?

Blood pressure is the force of the blood pushing against the artery walls during contraction and relaxation of the heart. Each time the heart beats, it pumps blood into the arteries, resulting in the highest blood pressure as the heart contracts. When the heart relaxes, the blood pressure falls.

Two numbers are recorded when measuring blood pressure. The higher number, or systolic pressure, refers to the pressure inside the artery when the heart contracts and pumps blood through the body. The lower number, or diastolic pressure, refers to the pressure inside the artery when the heart is at rest and is filling with blood.

Both the systolic and diastolic pressures are recorded as "mm Hg" (millimeters of mercury). This recording represents how high the mercury column in an old-fashioned manual blood pressure device (called a mercury manometer or sphygmomanometer) is raised by the pressure of the blood.

**High blood pressure**, or hypertension, directly increases the risk of heart attack, heart failure, and stroke. With high blood pressure, the arteries may have an increased resistance against the flow of blood, causing the heart to pump harder to circulate the blood.

Blood pressure is categorized as normal, elevated, or stage 1 or stage 2 high blood pressure:

- **Normal** blood pressure is systolic of less than 120 and diastolic of less than 80 (120/80)



- **Elevated** blood pressure is systolic of 120 to 129 **and** diastolic less than 80
- **Stage 1** high blood pressure is systolic is 130 to 139 **or** diastolic between 80 to 89
- **Stage 2** high blood pressure is when systolic is 140 or higher **or** the diastolic is 90 or higher

A single blood pressure measurement that is higher than normal is not necessarily an indication of a problem.

## What is Systolic blood pressure?

The peak (highest) blood pressure, it is measured during ventricular systole, it is 120 mmHg in a young person at rest.

## What is Diastolic blood pressure?

The minimum blood pressure, it is measured at the end of ventricular Diastole, it is 80 mmHg in a young person at rest.

## What is Pulse pressure?

It is the difference between systolic BP and diastolic BP.

Pulse pressure = systolic BP - diastolic BP

(e.g. :  $120 - 80 = 40 \text{ mmHg}$ )

## What is Mean blood pressure?

Mean BP:

Calculated by adding one-third of the pulse pressure to the diastolic BP

Mean BP = diastolic pressure +  $1/3$  (systolic pressure – diastolic pressure)

e.g. : if BP= 120/90 mmHg → diastolic BP= 90 , pulse pressure = 30

Mean BP: (diastolic BP) + (one-third of pulse pressure) = (90) + (30/3) = 90+10 = 100 mmHg



## Blood Pressure Measuring Methods

